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EP 0 421 965 B1

Description

The present invention relates to a flywheel device for internal combustion engines as defined by the preamble of claim 1. Such a flywheel device is known from GB-A-2 194 021.

In designing the drive chain for a passenger car with a manual transmission, in recent years greater attention has been paid to the problem of damping transmission noise such as rapping at idle and rattle. Rapping at idle occurs when the car is stationary and the engine is idling, while rattle occurs when the car is driven and the drive chain is loaded. Both are caused by the fact that the harmonic torque of the engine gives rise to a torsional oscillation cycle in the gearbox when the primary shaft of the gearbox is subjected to an angular acceleration by the primary shaft gear and its input shaft is then retarded by the engine and by the drag torque of the gearbox.

A known method of dampening rapping at idle and rattle is to reduce these torsional oscillations by dividing the engine flywheel into two masses with an intermediate torque transmitting spring and damping system. Such a system replaces the spring and damping device arranged in the disc center of a conventional clutch. The double mass flywheel with an intermediate spring system functions as a mechanical "low pass filter" and by suitable dimensioning of the components it can reduce the natural frequency of the torsional oscillations from 40 - 70 Hz, corresponding to the rpm range at which the engine operates under normal conditions, to about 15 Hz, which lies below the normal idle rpm of the engine.

The purpose of the present invention is to provide a two-mass flywheel of the type described which can be produced from relatively few components using simple and inexpensive manufacturing methods.

This is achieved by the features of claim 1.

The two masses, forming the main components of a two-mass flywheel, can consist of a pair of cast discs. By providing said discs during casting with facing circular depressions with fingers or projections extending from the bottom of said depressions in each disc, simple turning operations then suffice to finish both the cavity for the helical spring means and the abutments forming supports for the ends of the helical spring means.

The invention will be described in more detail below with reference to an example shown in the accompanying drawings, where

Fig 1 shows a longitudinal section through a first embodiment of a flywheel device according to the invention,

Fig 2 shows a cross section along the line II-II in Fig 1,

Fig 3 shows a longitudinal section through a second embodiment,

Fig 4 shows a cross-section along the line III-III in Fig 3, and

Fig 5 is a diagram showing the spring characteristic of the device in Figs 3 and 4.

The flywheel device consists of two separate masses, 1 and 2, which are rotatable relative to each other.

The mass 1 is made up of a cast and turned metal disc 1a with a shrunk-on gear rim 1b which is the engine's start rim. A disc 1a is designed to be screwed on to a flange (not shown) on the engine crank shaft end, and for this purpose it has mounting screw holes 4 spaced along a circle. Four pairs of fingers 5 and 6 are spaced at 90° angles, cast in one piece with the disc 1a, said fingers having facing machined surfaces 5a,6a. Radially inside the fingers 5,6 there is a pair of additional fingers 7, placed diametrically opposite to each other. Even the radially inner fingers 7 are cast in one piece with the plate 1a, and they have turned outer surfaces 7a,7b.

The mass 2 consists of a first cast and turned annular metal disc 10, forming a friction plate for a clutch, and a second cast and turned metal ring 11, forming a spring holder. The disc has a faced friction surface 12 for the clutch disc (not shown) and is provided in the vicinity of its periphery with screw holes 13 spaced along a circle, by means of which a clutch cover (not shown) with a pressure plate is securely screwed to the disc 10. In the vicinity of its inner periphery the disc 10 has holes 14 spaced along a circle.

The ring 11 has corresponding holes 15 and is fixed to the disc 10 by means of rivets 16 in the holes 14,15. The ring 11 is cast with a circular, essentially U-shaped channel 17, and with four fingers 18 projecting from the bottom of the channel, said fingers being displaced 90° from each other and oriented relative to the fingers 5,6 of the mass 1 so that each of said fingers 18 in a certain relative position of the masses 1 and 2, lies between an individual pair of fingers 5,6. The surface portion 17a,17b of the channel 17 on either side of the fingers 18 are turned as are the lateral surfaces 18a,18b of the fingers 18. The ring 11 is also cast with a circular channel 19 radially inside the channel 17. The portion 20 of the ring 11 radially inside the channel 19 forms a shoulder with a turned circular surface 21, serving as a bearing surface for the ring 30.

When casting the ring 11 on the second mass 2, there are created as well circular arcuate depressions 22 with an essentially U-shaped cross section and arranged in pairs. Between the depressions 22 in each pair there are circular-arcuate slots 23, into which the inner fingers 7 of the first mass 1 extend.

The ring 30 is a relatively thin metal ring, which can be stamped or cut and has a radially inner surface 31 which forms a bearing surface and rests against the surface 21 of the ring 11. The ring 30 is made in one piece with four oblong projections 32 evenly spaced about the periphery and which lie in the channel 17 of the ring 11. These projections have radially outer and inner abutments 32a, 32b for one end of helical springs 40 lying in the channel 17. The other end of each spring abuts against the fingers 5, 6 and 18, respectively, of the masses 1 and 2, respectively. As can be seen in Fig 2, the projections 32 are shaped and arranged so that the opposite ends of each projection extend into opposing spring ends, so that when the flywheel device is not subjected to torque, the projections 32 lie midway between pairs of adjacent groups of fingers 5, 6 and 18, as shown in Fig 2. In each channel portion 17 between two groups of fingers, there lie, in the example shown, two helical springs 40, which are held together by the ring 30 serving as a spring guide or holder.

The disc 1a of the mass 1 is made with depressions (not shown) which supplement the channel 17 and the depressions 22 in such a way that essentially closed cavities are formed, essentially circular in cross section for the springs 40 and the springs 41. The purpose of the latter is, by cooperation with the inner fingers 7, to damp impact when there is an extreme overloading of the system. The cavities defined by the disc 1a and the ring 11 are filled with a medium having lubricating and damping properties. The disc 1a is machined so that a flange 50 is formed which extends axially over the ring 11. A cover plate 51 is fixed to the end of said flange 50 with a seal 52 therebetween. The cover plate 51 has an inner flange 53 abutting against a seal 54 in a groove in a flange portion 55 of the disc 10. A further seal 56 in a groove in a radially inner flange 57 on the disc 1a completes the sealing-off of the cavities with respect to the surroundings.

Between the inner surface 50a of the flange 50 and an opposing radial surface of the ring 11, there is a radial bearing 60 in the form of a teflon ring for example. Axial forces in the system are taken up by a thrust-bearing 61 between the cover plate 51 and the ring 11 and a more central thrust-bearing 62 between the disc 1a and an end surface on the flange portion 55 of the disc 10.

As is evident from the above description, no other machining is required than turning and drilling in order to finish the flywheel discs 1a and 10 and the ring 11. Since the side surfaces 5a, 6a; 18a, 18b of the projections 5, 6; 18 are machined in a lathe, is provided an automatic fitting to the curvature of the cavity 17 as required to have a minimum of play between the surfaces 5a, 6a and

18a, 18b and still assure free displacement of the fingers 5, 6 relative to finger 18 when there is a relative rotation between the masses. That area of depression 17 in the ring 11 lying within those circles constituting the lateral limits of the fingers 18 cannot, for obvious reasons, be machined in a lathe. The same is true for the corresponding areas of the ring 1a, lying within circles constituting the lateral limits of the fingers 5 and 6. It has, however, been demonstrated that the desired functioning as regards low resistance to spring movement is achieved with or with only partial turning of the spring cavities. The most important feature is that the described design with one central and two lateral fingers 5, 6 and 18 provides for a symmetrical loading of the springs when compressed, thus avoiding oblique loading with consequent pressing of the springs against the side walls of the cavity.

Figs 3 and 4 show a modified embodiment of the device according to the invention which distinguishes from the embodiment described above essentially in that the fingers 18 have a peripheral dimension which is larger than that of the fingers 5, 6 and in that the ring 30 has been deleted. Components with counterparts in Figs 1 and 2 have the same reference numerals as in Figs 1 and 2. The fingers 18 and the pair of fingers 5, 6 in each group are, as is evident from Fig 4, arranged in relation to each other in the torque-unloaded state of the device, so that all three abut on one side against an adjacent spring end, while only the finger 18 abuts against the spring end on the opposite side. There is here instead a play "S1" or "S2" between the spring end and the adjacent fingers 5, 6. These plays "S1" and "S2" are adapted to the spring force so that at idle only the springs 40a are compressed. The plays "S1" and "S2" in the embodiment shown are different to compensate for the one-sided action of the springs, caused by the rotation of the flywheel in only one direction. These plays can, however, be equal in the torque-unloaded state. When the relative rotation of the masses exceeds the plays, the springs 40b are actuated, and this occurs during normal driving and during engine braking. The spring system has the characteristic shown in Fig 5, where the range "a" illustrates operation at idle with only the springs 40a being active. At normal operation, the spring system has the characteristic shown in range "b". At maximum torque the springs 41 are also brought into play, as illustrated by the characteristic in the range "c".

Claims

1. Flywheel device for internal combustion engines comprising a first flywheel mass (1) intended to be connected to an output shaft from

- the engine, a second flywheel mass (2) intended to be coupled via a friction coupling to an input shaft of a transmission, and spring means (40) acting between said masses for transmitting torques between said masses, wherein the masses (1,2) delimit together at least one cavity (17) curved in a circular arc in the direction of rotation, in which cavity helical spring means (40) are disposed, and that the masses are made with first and second abutments (5,6,18) projecting into the cavity, which abutments, in the torque-unloaded state of the masses, form supports for the ends of helical spring means lying on either side of the abutments and which, when there is torque-loading with relative rotation between the masses, are displaced in opposite directions to said spring means and wherein the first abutment (18) is joined to one (2) of the masses and abuts against central portions of facing ends of spring means (40), while the second abutment (5,6) is joined to the second mass (1) and abuts against portions of said ends, characterized in that said portions directed to the second abutment (5,6) lie radially outside and radially inside of said central portion.
2. Device according to Claim 1, characterized in that a first abutment is formed by a finger (18) made in one piece with the associated mass (2), while a second abutment is formed by a pair of fingers (5,6) formed in one piece with the second mass (1), said pair of fingers (5,6) being so spaced radially to each other relative to the radial dimension of the first finger, that the first finger can pass between the two other fingers upon relative rotation between the masses.
 3. Device according to Claim 2, characterized in that the circle-arcuately curved cavity (17) has an essentially circular cross-sectional profile and that the fingers (5,6,18) are so formed that they, when the masses are not subjected to torque, fill out at least essentially the entire cavity between facing ends of the spring means (40).
 4. Device according to Claim 2 or 3, characterized in that the fingers (5,6,18) are cast in one piece with the associated mass (1,2) and are machined in a lathe to the same curvature as the circle-arcuate cavity (17).
 5. Device according to one of Claims 1 - 4, characterized in that additional helical spring means (41) are arranged between the masses (1,2) in cavities (22) radially inside the first cavity (17) and that these additional helical spring means are so fixed relative to one mass in relation to cooperating abutments (7) on the other mass, that after a certain relative rotation between the masses, the last mentioned abutments come into contact with the spring means.
 6. Device according to one of Claims 1 - 5, characterized in that at least two abutment groups (5,6,18) project into the cavity and that the helical spring means (40) fill out the cavity sections between the groups of abutments when the masses are not subjected to torque.
 7. Device according to Claim 6, characterized in that the first and second fingers (18;5,6) in each group have different peripheral dimensions and are arranged relative to first and second helical spring means (40a,40b) arranged therebetween so that initial relative rotation between the masses (1,2) from the torque-unloaded state results in a compression of only one spring means (40a).
 8. Device according to Claim 7, characterized in that four groups of first and second fingers (18;5,6) with different peripheral dimensions are provided and that two pairs of first and second spring means (40a,40b) are grouped so that said initial relative rotation leads to a compression of diametrically opposite spring means.
 9. Device according to Claim 7 or 8, characterized in that the first abutment (18) has a larger peripheral dimension than the second abutment (5,6) and that - in the torque-unloaded state of the masses - the spring means (40a) on one side of each abutment group abut against both abutments, while spring means (40b) on the opposite side only abut against the first abutment.
 10. Device according to one of Claims 1 - 6, characterized in that an annular element (30) rotatably journaled on one of the masses, has projections (32) engaging with the spring means (40) for balancing centrifugal and reaction forces acting on the spring means.

Patentansprüche

1. Schwungrad für Verbrennungsmotoren mit einer ersten Schwungradmasse (1), die dazu bestimmt ist, mit der Abtriebswelle des Motors verbunden zu werden, einer zweiten Schwungradmasse (2), die dazu bestimmt ist, über

- eine Reibungskupplung mit der Eingangswelle eines Getriebes verbunden zu werden, sowie mit Federn (40), die zum Übertragen von Drehmoment zwischen beiden Massen liegen und wirksam sind, wobei die Massen (1, 2) gemeinsam wenigstens einen Hohlraum (17) abgrenzen, der in Drehrichtung kreisförmig gekrümmt ist und in dem Schraubenfedern (40) liegen, wobei die Massen mit ersten und zweiten Anschlägen (5, 6, 18) versehen sind, die in den Hohlraum hineinragen und die in einem mit Drehmoment unbelasteten Zustand der Massen Stützteile für die Enden der Schraubenfedern bilden, die an beiden Seiten der Anschläge anliegen und die dann, wenn eine Drehmoment-Belastung mit einer relativen Drehung zwischen den Massen stattfindet, in entgegengesetzte Richtungen zu den Federn verschoben werden, wobei die ersten Anschläge (18) mit einer (2) der Massen verbunden sind und gegen die mittigen Abschnitte der Stirnenden der Federn (40) anstoßen, während die zweiten Anschläge (5, 6) mit der zweiten Masse (1) verbunden sind und gegen Teile dieser Enden anstoßen, **dadurch gekennzeichnet**, daß diese Teile, die den zweiten Anschlägen (5, 6) zugewandt sind, radial außerhalb und radial innerhalb des mittigen Abschnitts liegen.
2. Schwungrad nach Anspruch 1, **dadurch gekennzeichnet**, daß ein erster Anschlag durch einen Finger (18) gebildet wird, der mit der zugeordneten Masse (2) einstückig ist, während ein zweiter Anschlag durch ein Fingerpaar (5, 6) gebildet wird, das mit der zweiten Masse (1) einstückig ausgebildet ist, wobei das Fingerpaar (5, 6) relativ zur radialen Abmessung des ersten Fingers so weit voneinander entfernt ist, daß der erste Finger zwischen den beiden anderen Fingern bei einer relativen Drehung zwischen den Massen hindurchgehen kann.
 3. Schwungrad nach Anspruch 2, **dadurch gekennzeichnet**, daß der kreisförmig gekrümmte Hohlraum (17) einen im wesentlichen kreisförmigen Querschnitt hat und daß die Finger (5, 6, 18) so ausgebildet sind, daß sie dann, wenn die Massen von keinem Drehmoment beeinflußt werden, wenigstens im wesentlichen den gesamten Hohlraum zwischen den aufeinanderzuweisenden Enden der Federn (40) ausfüllen.
 4. Schwungrad nach einem der Ansprüche 2 oder 3, **dadurch gekennzeichnet**, daß die Finger (5, 6, 18) einstückig mit den zugeordneten Massen (1, 2) gegossen sind und daß sie auf einer Drehbank auf dieselbe Krümmung bearbeitet sind wie der kreisförmige Hohlraum (17).
 5. Schwungrad nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet**, daß zusätzliche Schraubenfedern (41) zwischen den Massen (1, 2) in Hohlräumen (22) angeordnet sind, die radial innerhalb des ersten Hohlraums (17) liegen, und daß diese zusätzlichen Schraubenfedern relativ zur einen Masse in bezug auf zusammenwirkende Anschläge (7) an der anderen Masse so befestigt sind, daß nach einer bestimmten, relativen Drehung zwischen den Massen die zuletzt erwähnten Anschläge mit der Feder in Berührung kommen.
 6. Schwungrad nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet**, daß wenigstens zwei Anschlaggruppen (5, 6, 18) in den Hohlraum ragen und daß die Schraubenfedern die Hohlraumabschnitte zwischen den Anschlaggruppen dann ausfüllen, wenn die Massen einem Drehmoment nicht unterworfen sind.
 7. Vorrichtung nach Anspruch 6, **dadurch gekennzeichnet**, daß die ersten und zweiten Finger (18; 5, 6) in jeder Gruppe unterschiedliche Umfangsabmessungen haben und relativ zu ersten und zweiten Schraubenfedern (40a, 40b), die zwischen den Fingern angeordnet sind, so angebracht sind, daß eine anfängliche relative Drehung zwischen den Massen (1, 2) von einem mit Drehmoment unbelasteten Zustand aus zu einer Kompression lediglich einer Feder (40a) führt.
 8. Vorrichtung nach Anspruch 7, **dadurch gekennzeichnet**, daß vier Gruppen erster und zweiter Finger (18; 5, 6) mit unterschiedlichen Umfangsabmessungen vorgesehen sind und daß zwei Paare erster und zweiter Federn (40a, 40b) so gruppiert sind, daß die erwähnte, relative Anfangsdrehung zu einer Kompression von diametral einander gegenüberliegenden Federn führt.
 9. Schwungrad nach einem der Ansprüche 7 oder 8, **dadurch gekennzeichnet**, daß der erste Anschlag (18) eine größere Umfangsabmessung hat als die zweiten Anschläge (5, 6) und daß die Feder (40a) auf einer Seite jeder Anschlaggruppe im mit Drehmoment unbelasteten Zustand der Massen gegen beide Anschläge anliegt, während die Feder (40b) auf der gegenüberliegenden Seite lediglich am ersten Anschlag anliegt.

10. Schwungrad nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet**, daß auf einer der Massen ein ringförmiges Element (30) drehbar gelagert ist, das zum Ausgleich von zentrifugalen und Reaktionskräften, die auf die Federn einwirken, Vorsprünge (32) hat, die mit den Federn (40) im Eingriff sind.

Revendications

1. Dispositif formant volant d'inertie pour moteurs à combustion interne, comportant une première masse (1) de volant d'inertie prévue pour être reliée à un arbre de sortie du moteur, une seconde masse (2) de volant d'inertie prévue pour être reliée via un accouplement à friction à un arbre d'entrée d'une transmission, et des moyens formant ressorts (40) agissant entre lesdites masses pour transmettre des couples entre lesdites masses, dans lequel les masses (1, 2) délimitent ensemble au moins une cavité (17) incurvée en arc de cercle dans la direction de rotation, cavité dans laquelle sont agencés les moyens (40) formant ressorts hélicoïdaux, et en ce que les masses sont munies de première et seconde butées (5, 6, 18) faisant saillie à l'intérieur de la cavité, lesquelles butées, dans l'état des masses non chargé par un couple, forment des supports pour les extrémités des moyens formant ressorts hélicoïdaux situés de chaque côté des butées et qui, lorsqu'il existe une charge par un couple avec rotation relative entre les masses, sont déplacées dans des directions opposées auxdits moyens formant ressorts et dans lequel la première butée (18) est reliée à une première (2) des masses et vient en butée contre des parties centrales d'extrémités opposées des moyens (40) formant ressorts, alors que la seconde butée (5, 6) est reliée à la seconde masse (1), et vient en butée contre des parties desdites extrémités caractérisé en ce que lesdites parties dirigées vers la seconde butée (5, 6) se trouvent radialement vers l'extérieur et radialement vers l'intérieur de ladite partie centrale.
2. Dispositif selon la revendication 1, caractérisé en ce qu'une première butée est formée par un doigt (18) réalisé en une seule pièce avec la masse associée (2) alors qu'une seconde butée est formée par une paire de doigts (5,6) formée en une seule pièce avec la seconde masse (1), ladite paire de doigts (5, 6) étant espacée l'une de l'autre radialement par rapport à la dimension radiale du premier doigt, de telle sorte que le premier doigt peut passer entre les deux autres doigts lors d'une rotation

relative entre les masses.

3. Dispositif selon la revendication 2, caractérisé en ce que la cavité (17) incurvée en arc de cercle a un profil en coupe pratiquement circulaire et en ce que les doigts (5, 6, 18) sont formés de telle sorte que lorsque les masses ne sont pas soumises à un couple, ils remplissent au moins pratiquement toute la cavité existant entre les extrémités opposées des moyens (40) formant ressort.
4. Dispositif selon la revendication 2 ou 3, caractérisé en ce que les doigts (5, 6, 18) sont moulés en une seule pièce avec les masses associées (1, 2) et sont usinés dans un tour pour avoir la même courbure que la cavité (17) en arc de cercle.
5. Dispositif selon l'une quelconque des revendications 1 à 4, caractérisé en ce que des moyens (41) formant ressorts hélicoïdaux supplémentaires sont agencés entre les masses (1, 2) dans des cavités (22) situées radialement à l'intérieur par rapport à la première cavité (17) et en ce que ces moyens formant ressorts hélicoïdaux supplémentaires sont fixés par rapport à une première masse en étant en relation avec des butées complémentaires (7) situées sur l'autre masse, de sorte qu'après une certaine rotation relative entre les masses, les dernières butées citées viennent en contact avec les moyens formant ressorts.
6. Dispositif selon l'une quelconque des revendications 1 à 5, caractérisé en ce qu'au moins deux groupes de butées (5, 6, 18) font saillie à l'intérieur de la cavité et en ce que les moyens (40) formant ressorts hélicoïdaux remplissent les tronçons de cavité situés entre les groupes de butées lorsque les masses ne sont pas soumises à un couple.
7. Dispositif selon la revendication 6, caractérisé en ce que les premiers et seconds doigts (18; 5, 6) de chaque groupe ont des dimensions périphériques différentes et sont agencés par rapport aux premiers et seconds moyens (40a, 40b) formant ressorts hélicoïdaux agencés entre eux de sorte qu'une rotation relative initiale entre les masses (1, 2) à partir de l'état non chargé par un couple entraîne une compression d'un seul (40a) des moyens formant ressorts.
8. Dispositif selon la revendication 7, caractérisé en ce que quatre groupes de premiers et seconds doigts (18; 5, 6) ayant des dimensions

périphériques différentes sont agencés et en ce que deux paires de premiers et seconds moyens (40a, 40b) formant ressorts sont groupées de telle sorte que ladite rotation relative initiale aboutit à une compression des moyens formant ressorts diamétralement opposés.

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9. Dispositif selon la revendication 7 ou 8, caractérisé en ce que la première butée (18) a une dimension périphérique plus grande que la seconde butée (5, 6) et en ce que, dans l'état des masses non chargé par un couple, les moyens (40a) formant ressorts situés sur un côté de chaque groupe de butées vient en butée contre les deux butées, alors que les moyens (40b) formant ressorts situés sur le côté opposé viennent en butée uniquement contre la première butée.

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10. Dispositif selon l'une quelconque des revendications 1 à 6, caractérisé en ce qu'un élément annulaire (30) tourillonné de manière rotative sur l'une des masses, a des saillies (32) coopérant avec les moyens (40) formant ressorts pour équilibrer les forces centrifuges et de réaction agissant sur les moyens formant ressort.

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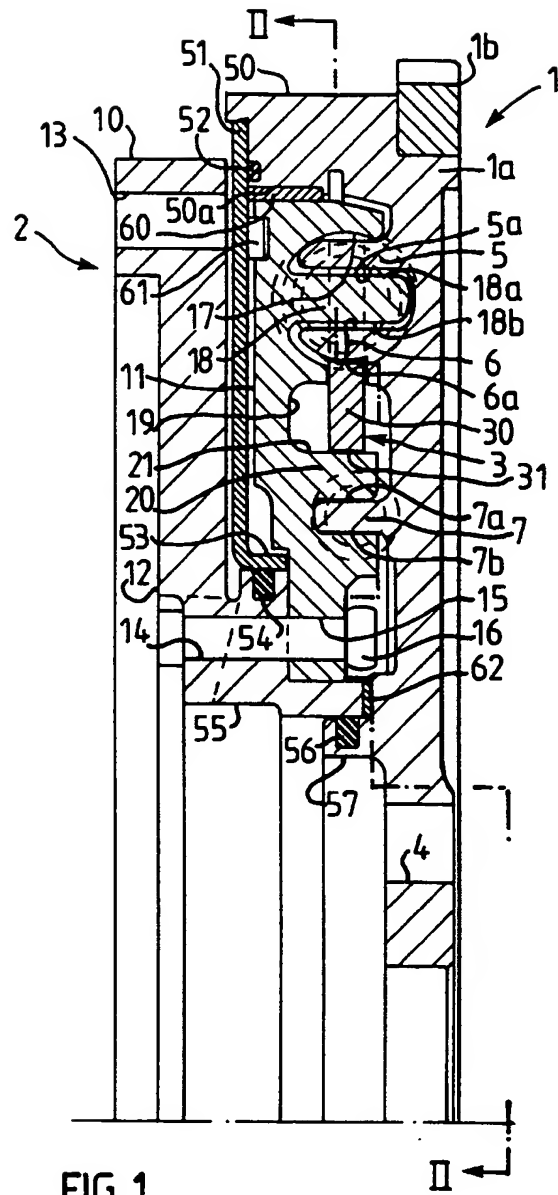
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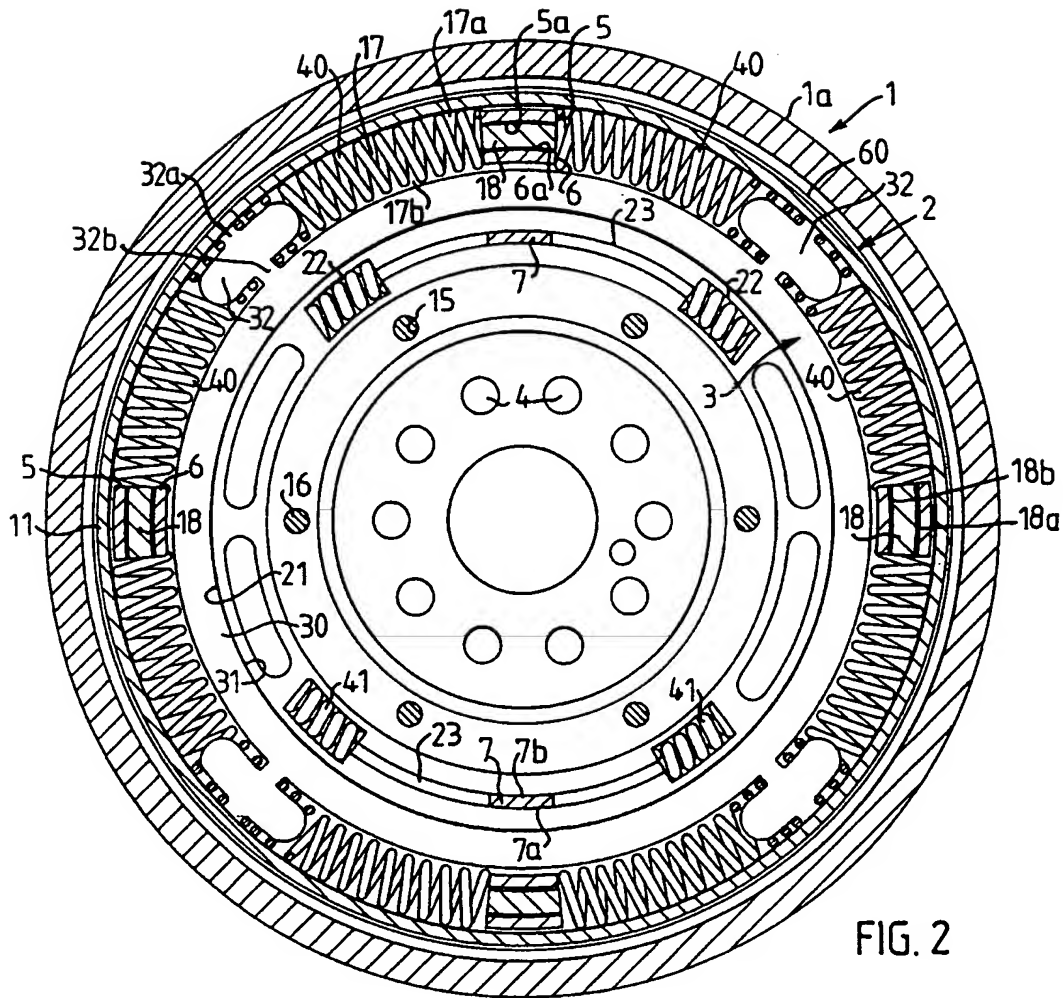


FIG. 2

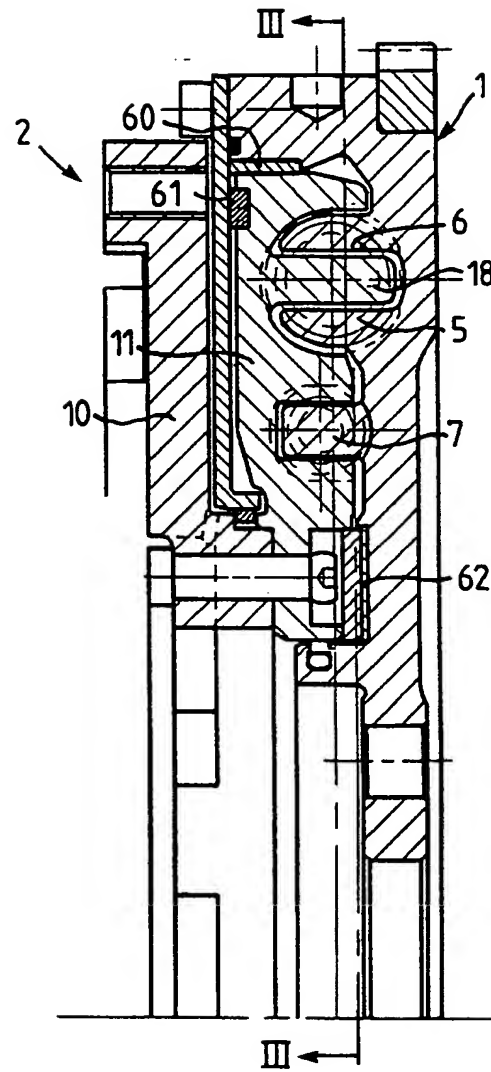


FIG. 3

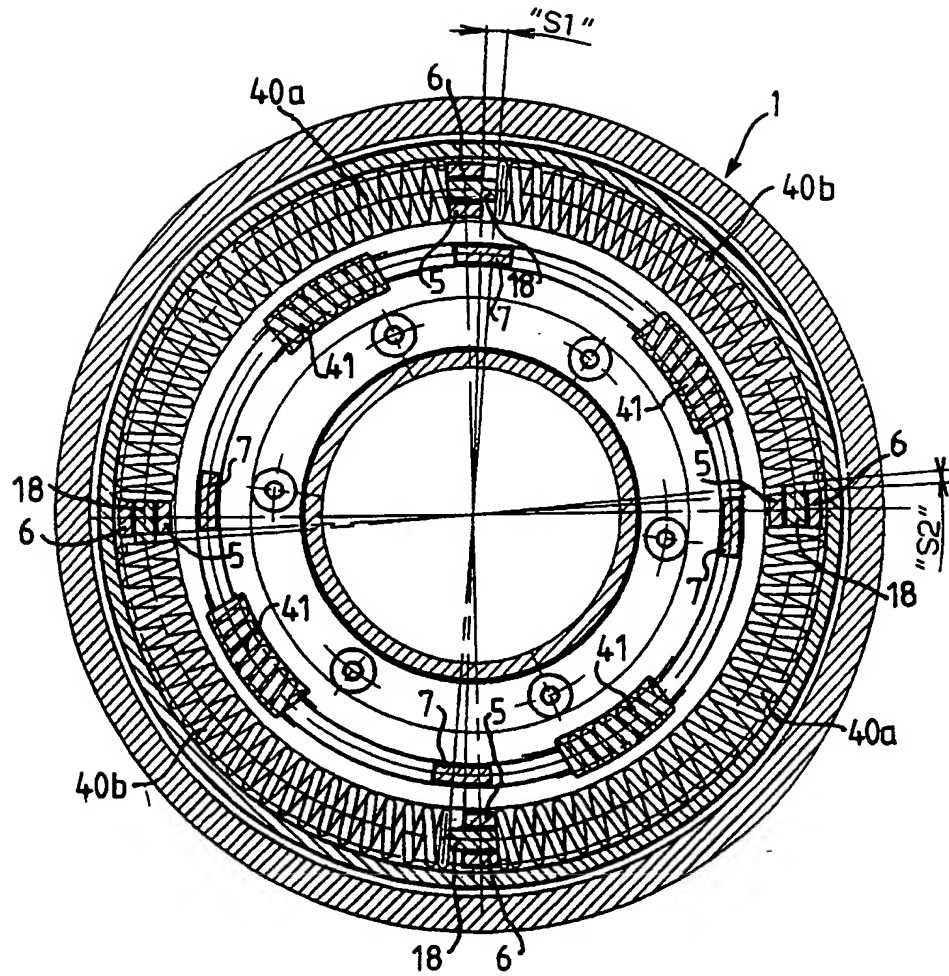


FIG.4

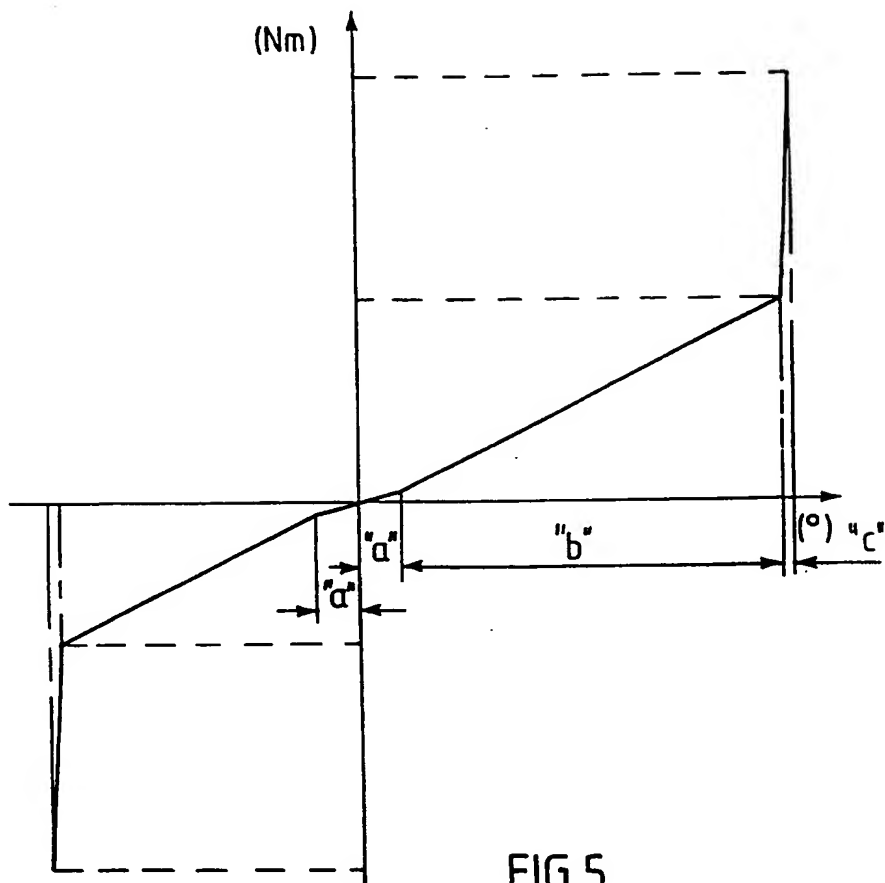


FIG.5